Diabetes-Related Deaths in Missouri 1989-1994

A. Neal Sprick; Eduardo J. Simoes, MD, MSc, MPH;
C. Bridget McKeage, PhD; Jian C. Chang, PhD

Introduction

Statistics based on deaths resulting from a disease are significant indicators of the burden of that disease. The following report describes data about diabetes-related mortality among residents of the state of Missouri for six years from 1989 through 1994.

Diabetes mellitus is a leading cause of death and disability in the United States. An estimated 16 million Americans have diabetes, with only about half who have it adequately diagnosed and are under treatment for the disease. In 1992, diabetes cost the nation an estimated $92 billion in direct medical and indirect costs.[1] Using these national figures, it is estimated that more than 300,000 Missourians have diabetes and that Missouri's share of the nation's cost is nearly $2 billion. Both the number of cases and the financial cost of diabetes are increasing each year.

In 1994, diabetes was the seventh leading cause of death for white Missourians, and the sixth leading cause of death for African-American Missourians.[2] Diabetes has been ranked among the top 10 causes of death in the nation since 1932.[3] Before the introduction of insulin in the 1920s, diabetic coma was the predominant cause of diabetes-related deaths for persons with insulin-dependent diabetes mellitus (IDDM), but since insulin, heart disease and kidney disease predominate.[4] For persons with non-insulin-dependent diabetes mellitus (NIDDM), ischemic heart disease accounts for about 40% of the deaths.[5] Although cardiovascular diseases are the leading cause of death for all persons, those with diabetes are at two to three times greater risk of dying from cardiovascular disease.[6] Diabetes also accounts for about 35% of all new cases of end-stage renal disease.[7]

Method

Deaths reported with diabetes listed anywhere in the "cause of death" section on the certificate of death are considered diabetes-related mortality for this report. The findings were based solely on data recorded on the certificates of death as compiled by the Missouri Department of Health for the years 1989 through 1994. No investigations were conducted to validate the accuracy of the information contained in the certificates. Population estimates were obtained from United States census publications.

Data for diabetes-related mortality was not included from the years prior to 1989 because a new national standard certificate of death was adopted by the state of Missouri in 1989. The changes in the form appear to have affected the way causes of death were reported, and the number of certificates with diabetes as the underlying cause of death increased by 32% between 1988 and 1989. Other states experienced similar increases in the number of diabetes deaths when they changed to the new form. The increases may have resulted from an extra line added to the "underlying cause" section.[8] Missouri data since 1989 reflects more gradual changes year to year.

The major demographic characteristics of the deceased persons, including age, sex, race, and place of residence were examined. Only two racial-ethnic groups were included because of the small and unreliable numbers available for other races. For this report, Missouri counties are grouped into urban and rural areas. All counties with 1990 populations 100,000 or greater and the city of St. Louis are in the urban group, and all other counties are in the rural group. Rates have been age-adjusted to the 1940 United States population.

Reprinted from *Missouri Medicine* January 1998;95(1):21-25.

Results

Table 1 depicts the annual number of diabetes-related deaths reported for Missouri residents in the years 1989 through 1994. During that time, 6,741 death certificates for Missouri residents listed diabetes as the underlying cause, and an additional 15,658 certificates had diabetes as another listed cause. These 22,399 deaths represent 7.2% of all deaths of Missouri residents reported during those years. The number of diabetes-related deaths in Missouri increased annually from 3,413 in 1989 to 3,709 in 1991, decreased slightly to 3,662 in 1992, and then increased to 4,035 in 1994. Except for a small drop in 1992, the age-adjusted death rate gradually increased from 34.8 per 100,000 persons in 1989 to 39.2 per 100,000 persons in 1994. The annual rate for diabetes-related deaths for the six year period was 37.8 per 100,000 Missouri residents.

Table 1.
Diabetes-Related (DM) Deaths by Year
Residents of the State of Missouri 1989-1994

Year	Total Deaths	DM Deaths	% Total	Rate*
1989	50,424	3,413	6.8%	34.8
1990	50,372	3,548	7.0%	36.1
1991	50,876	3,709	7.3%	37.7
1992	50,960	3,662	7.2%	36.7
1993	53,728	4,032	7.5%	39.2
1994	53,611	4,035	7.5%	39.2
TOTAL	309,971	22,399	7.2%	37.8

*Diabetes-related deaths per 100,000 population age-adjusted to 1940 U.S. population.

Table 2 shows the top 10 leading causes of death in Missouri for persons with diabetes. In the death certificates examined for this report, diseases of the heart were listed as the underlying cause in 10,259 deaths (45.8% of the total), with kidney disease listed for 177 deaths (0.8%). Diabetic coma (hyperosmolar coma, coma with ketoacidosis, hypoglycemic coma, and insulin coma, not otherwise specified) was listed as the underlying cause on 41 certificates (0.2%). Other major causes of death for persons with diabetes include cancer, chronic lung disease, pneumonia, and liver disease.

Table 2.
10 Leading Underlying Causes of Death
Diabetes-Related (DM) Deaths
Residents of the State of Missouri 1989-1994

Listed as Underlying Cause DM Deaths	# Deaths	%DM Deaths
1. Diabetes	6,741	30.1%
2. Ischemic Heart Disease	6,481	28.9%
3. Cancer	2,262	10.1%
4. Cardiovascular Disease	1,848	8.3%
5. Stroke	1,513	6.8%
6. Chronic Lung Disease	562	2.5%
7. Pneumonia	501	2.2%
8. Hypertension	417	1.9%
9. Renal Failure	177	0.8%
10. Liver Disease	146	0.7%

Table 3 shows that in the years 1989 to 1994, persons aged 75 and older accounted for 53% of the diabetes-related deaths among Missourians. Persons aged 65 through 74 accounted for another 27.6%, and 19% of the diabetes-related deaths occurred in those under the age of 65. In all deaths due to all causes reported during this time, 54% were persons 75 or older and 21% were aged 65 through 74. The mean age at death for diabetes-related deaths was 73.8, compared to 71.4 for all deaths.

Table 3.
Diabetes-Related (DM) Deaths by Age by Year*
Residents of the State of Missouri 1989-1994

Year	Age 0-44	Age 45-64	Age 65-74	Age 75+
1989	89	573	908	1,843
Rate	2.6	58.8	231.4	579.7
1990	82	603	1,021	1,842
Rate	2.4	61.5	259.0	568.8
1991	101	642	1,036	1,930
Rate	2.9	65.3	261.4	585.4
1992	103	616	1,027	1,916
Rate	3.0	61.2	256.5	573.9
1993	109	635	1,111	2,177
Rate	3.1	61.9	275.2	645.6
1994	108	676	1,082	2,169
Rate	3.1	64.5	267.4	637.1
TOTAL	592	3,745	6,185	11,877
Rate	2.9	62.2	258.5	598.4

*Age-specific rates of death per 100,000 population.

Table 4 also shows more diabetes-related deaths for women than for men. Women accounted for 12,558 of the deaths reported (56.1%) while men accounted for 9,841 (43.9%) of these deaths. For all Missouri deaths during the same period, approximately 50% were women and 50% were men. While the ratio of diabetes-related deaths among women compared to men was 1.3 to 1, the age-adjusted rate of diabetes-related deaths for men is higher at 42.9 per 100,000, compared to 34.0 per 100,000 for women. In general, the rate of diabetes-related deaths increased from 1989 to 1994 for men, ranging from 38.1 to 44.9 per 100,000 males. Similar to the population trend, there was a slight decrease in the death rate for men in 1992. For women, the death rate increased and decreased over the six year period, ranging from 32.4 per 100,000 women in 1989 to 34.7 per 100,000 women in 1994. The mean age at death for diabetes-related deaths was 71.6 for men and 75.5 for women. For diabetes-related deaths among persons aged 65 and younger, the number of deaths was 2,351 (54.2%) among men and 1,987 (45.8%) among women.

Table 4.
Diabetes-Related (DM) Deaths by Sex
Residents of the State of Missouri 1989-1994

Year	Males	Rate*	Females	Rate*
1989	1,451	38.1	1,962	32.4
1990	1,575	41.2	1,973	32.3
1991	1,637	42.3	2,072	34.3
1992	1,618	41.6	2,044	33.0
1993	1,766	44.2	2,266	35.4
1994	1,794	44.9	2,241	34.7
TOTAL	9,841	42.9	12,558	34.0

* Diabetes-related deaths per 100,000 population age-adjusted to 1940 U.S. population.

African-Americans accounted for 13.2% of the reported diabetes-related deaths during this period, which was approximately 23% greater than their representation in Missouri's population as reported in the 1990 census. As shown in Table 5, the age-adjusted diabetes-related death rate for African-Americans was 76.5 per 100,000, compared to 34.6 per 100,000 for the white population, demonstrating a 2.2 times greater death rate for African-Americans. From 1989 to 1994 the death rate for whites increased every year except in 1992. In contrast, the death rates for African-Americans fluctuated from year to year, with the lowest rate in 1992 (71.7 per 100,000 persons) and the highest rate in 1993 (79.4 per 100,000 persons). The death rate was 36.8 per 100,000 for African-Americans and 12.6 per 100,000 for whites aged 65 and younger. For diabetes-related deaths among African-Americans aged 65 and younger, 48% were men and 52% were women.

Table 5.
Diabetes-Related (DM) Deaths
White and African-American
Residents of the State of Missouri 1989-1994

Year	White	Rate**	African American*	Rate**
1989	2,923	31.5	484	74.6
1990	3,066	32.9	475	73.8
1991	3,205	34.5	495	75.9
1992	3,186	33.7	465	71.7
1993	3,493	35.8	526	79.4
1994	3,513	36.3	517	77.1
TOTAL	19,386	34.6	2,962	76.5

* Residents with race classified as "Other" are not included because of small numbers.
** Diabetes-related deaths per 100,000 population age-adjusted to 1940 U.S. population.

Table 6 depicts the geographical distribution of diabetes-related deaths by grouping counties with populations greater than 100,000 in the 1990 census into the "urban" group (17 counties), and counties with populations less than 100,000 into the "rural" group (98 counties). The urban counties (including the city of St. Louis) accounted for 14,258 (63.7%) of the diabetes-related deaths, with an age-adjusted death rate of 40.5 per 100,000, and rural counties accounted for 8,141 deaths (36.3%), a rate of 33.6 per 100,000. For African-American persons, 89.0% of the deaths occurred among residents of the urban counties.

Discussion

Diabetes is a major cause of death in Missouri and the rate of reported diabetes-related deaths is

Table 6.
Diabetes-Related (DM) Deaths
Urban and Rural
Residents of the State of Missouri 1989-1994

Year	Urban	Rate*	Rural	Rate*
1989	2,169	37.0	1,244	31.4
1990	2,266	38.7	1,282	31.9
1991	2,345	40.3	1,364	33.3
1992	2,327	39.0	1,335	33.2
1993	2,550	42.1	1,482	35.1
1994	2,601	42.7	1,434	33.8
TOTAL	14,258	40.5	8,141	33.6

* Diabetes-related deaths per 100,000 population age-adjusted to 1940 U.S. population.

increasing about 3% per year. Most deaths for persons with diabetes are caused by heart disease. In addition, persons with diabetes are more likely to develop heart disease than those without diabetes. The age-adjusted death rate for persons with NIDDM is approximately twice that of persons who do not have diabetes.[5] Persons aged 65 and older accounted for more than 80% of the reported diabetes-related deaths in Missouri. After the advent of insulin for the treatment of diabetes, deaths related to IDDM shifted from younger to the middle or later years of life.[4] However, a significant number of deaths occurred among persons with diabetes under 65, most notably among men. Although women accounted for more than 56% of the deaths in these data, the age-adjusted rate for men is higher, suggesting that diabetes has more impact on men at a younger age. Diabetes is 1.4 times more frequently diagnosed in African-American adults than in white adults.[9] Findings from the Missouri mortality data revealed the age-adjusted rate for African-Americans was 2.2 times that of the white population. The rate of diabetes-related deaths is higher in urban areas, possibly reflecting problems with access to high quality diabetes care and patient education services for some individuals.

There are similarities as well as differences between the patterns of diabetes-related mortality found in Missouri and those found in the United States. Based on data collected from the 1986 National Mortality Followback Survey (NMFS), diabetes deaths accounted for 17.2% of all deaths in the United States in 1986.[5] In Missouri, death certificate data revealed that the proportion of deaths that were diabetes-related was much lower, ranging from 6.8% to 7.5% of all deaths from 1989 to 1994. In the United States, data from death certificates indicates that 7.5% of all deaths in 1990 were diabetes-related (i.e., diabetes listed as any cause of death).[5] Similarly, diabetes-related deaths accounted for 7% of all deaths in Missouri in 1990 according to death certificate data. Diabetes was listed as the underlying cause of death for 2.2% of all deaths in Missouri in the 1989 to 1994 period (not in tables), which is consistent with the proportion of deaths listing diabetes as the underlying cause in the United States in 1990 (2.2%). In both Missouri and the United States, diabetes is the seventh leading underlying cause of death according to death certificate data.[2,5]

The leading underlying causes of death for persons with diabetes are the same for Missouri and the United States. According to 1990 United States death certificates in which diabetes was listed as a cause of death, the leading causes of death were cardiovascular diseases (including ischemic heart disease), diabetes, cancer, and stroke.[5] As shown in Table 2, the five leading underlying causes of death for diabetes-related deaths in Missouri are diabetes, ischemic heart disease, cancer, cardiovascular disease, and stroke. The proportion of diabetes deaths in Missouri (1989-1994) in which these diseases were listed as the underlying cause of death was similar to the United States (1990). In both Missouri and the United States, diabetes was listed as the underlying cause for approximately 30% of the diabetes-related deaths, ischemic heart disease was the underlying cause for 28.9% of the deaths, cancer was listed as the underlying cause for about 10%, and stroke was the underlying cause for 6.8% of the diabetes-related deaths.[5] Overall, diseases of the heart accounted for approximately 39% of deaths of persons with diabetes in the United States in 1990, while in Missouri diseases of the heart were listed as the underlying cause for nearly 46% of diabetes-related deaths (1989-1994).[5]

Information about diabetes mortality derived from death certificate data does have some serious limitations and inaccuracies. Several researchers have estimated that less than 40% of deaths among persons with medical histories of diabetes have diabetes listed anywhere as a cause of death on the death certificate. The degree to which diabetes contributes to death varies, and the completion and coding of death certificates may not always adequately represent the involvement of diabetes.[4]

Therefore, it is surmised that diabetes as an immediate, underlying or contributing cause of death may be underreported on Missouri certificates of death. The number of diabetes-related deaths during the six years examined in this study may in actuality be in excess of 50,000.

The Missouri Department of Health Diabetes Control Program conducts surveillance activities to better define the burden of diabetes in our state. It is important to identify and understand the populations most severely affected by diabetes. The program staff utilizes diabetes-related data from a variety of sources to examine trends in morbidity, mortality, and disability. The staff uses this information for the development of policies, to plan strategies to prevent unnecessary mortality in high-risk populations, and to reduce the overall burden of diabetes in Missouri. Since mortality data is a key component of the diabetes surveillance system, increased effort must be devoted to improving the accuracy with which death certificates are completed. Additional training should be provided to medical students, physicians, and other health professionals that demonstrates how to fill in the information completely and accurately, especially the cause of death section. The findings of this study support the Missouri Diabetes Control Program's efforts to target minority, elderly, and urban populations through secondary prevention activities. The findings of this study suggest further investigations are needed to continue to define the burden of diabetes in terms of direct and indirect costs and effective strategies for the early diagnosis, treatment of this condition, and prevention of its complications. The authors welcome questions, comments, and suggestions regarding any aspect related to the public health realm of controlling diabetes in Missouri. MoMed

Acknowledgments

The authors are grateful to the Center for Health Information Management and Epidemiology, Missouri Department of Health, which collects the death certificate data; and to Angelia Y. Weaver and Katherine A. Dent, coordinators of the Missouri Diabetes Control Program.

References

1. Public Health Service. National Diabetes Fact Sheet. Atlanta, GA: Centers for Disease Control and Prevention; 1995.
2. Missouri Department of Health. Missouri Vital Statistics 1994. Jefferson City, MO: State Center for Health Statistics; 1995.
3. Harris MI. Undiagnosed NIDDM: Clinical and public health issues. *Diabetes Care.* 1993; 16:642-652 as cited by Bishop DB, et al. Diabetes. In: Brownson RC, Remington PL, Davis JR eds. Chronic Disease Epidemiology and Control. Washington, DC: American Public Health Association; 1993; 241-255.
4. Portuese E, Orchard T. Mortality in Insulin Dependent Diabetes. In Harris MI, ed. *Diabetes in America.* Bethesda, MD: US Department of Health and Human Services, 1995: 221-232.
5. Geiss L, Herman WH, Smith PJ. Mortality in Non-Insulin-Dependent Diabetes. In Harris MI, ed. *Diabetes in America.* Bethesda, MD: US Department of Health and Human Services, 1995: 233-255.
6. Public Health Service. The Prevention and Treatment of Complications of Diabetes. Atlanta, GA: Centers for Disease Control and Prevention; 1991. p. 59.
7. Nelson RG, Knowler WC, Pettit DJ, Bennett PH. Kidney Disease in Diabetes. In Harris MI, ed. *Diabetes in America.* Bethesda, MD: US Department of Health and Human Services, 1995: 349-385.
8. Ferrara PR, Remington P. Diabetes Mortality Trend in Wisconsin and the United States, 1979-1991. *Wisconsin Medical Journal,* March, 1996: 174-175.
9. Tull ES, Roseman JM. Diabetes in African-Americans. In Harris MI, ed. *Diabetes in America.* Bethesda, MD: US Department of Health and Human Services, 1995: 613-630.